Volatility Spillover influences and Response Asymmetries of Interest Rates, Exchange Rates, and Banking Stock Returns: Evidence from Banks Listed in the Nairobi Securities Exchange

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ABSTRACT

This study examines response asymmetries and volatility spillover dynamics of Interest rates, Exchange Rates and returns of a portfolio comprised of Kenyan banks that are listed in the Nairobi Securities Exchange. The study employs [1] Exponential Generalized Autoregressive Conditionally Heteroscedastic (EGARCH) model for empirical modeling. The results suggest the presence of own transmission of returns in the banking sector. Further, they yield evidence of own transmission, high persistence, and asymmetric response of volatility in banking stock returns. Additionally, there is evidence of cross transmission of volatility from exchange rates to banking sector returns. The findings have several policy implications for investors, bank managers, and regulators.

Keywords: EGARCH Model, Interest rates, Exchange rates, Bank stock returns

1 Introduction

The interplay between the macroeconomic environment and the banking sector is a fundamental one. The financial services sector - of which the banking industry is most critical - has the highest tendency of reacting to movements in key macroeconomic indicators [2]. Thus, this study seeks to investigate the extant dynamic linkages between two crucial macroeconomic indicators (exchange rates and interest rates) and returns of listed banking stocks.

With regard to the relationship between exchange rates and stock returns [3] note that exchange rates and stock prices are the most intricately linked to all macroeconomic indicators. They argue that theoretically, exchange rate movements have a definite influence on stock returns, since an appreciation (depreciation) in a domestic currency reduces(increases) their competitiveness in the international market, thereby depressing(enhancing) their profits and hence stock returns. Thus, shocks to exchange rates have a direct transmission channel which enables them to influence volatility of bank stock returns. Consequently, understanding the co-movement dynamics of these variables is equally important to policy makers and international investors.

The relationship between interest rates and volatility bank stock returns is more straightforward: [4] note that when interest rates rise (fall), banks tend to have more (less) earnings from their

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loan portfolios, since their profits are directly indexed to their lending rates. Therefore, any unanticipated movements in interest rates are bound to elevate the conditional volatility of bank stock returns.

Although the foreign exchange market in Kenya has been fairly calm in the recent past, the same cannot be deemed true for interest rates. A significant disruption was occasioned by the interest rate capping regulations that were introduced by the Banking (Amendment) Act, 2016. However, these regulations have since been repealed but their effects on banking institutions still linger.

Inasmuch as there is a considerable body of knowledge on the interplay of interest and foreign exchange rates and banking stock returns, there is a dearth in the literature on the spillover of time varying volatility from macroeconomic indicators to banking sector returns with a particular focus on Africa.

Some studies [5, 6, and 7] assume a constant variance, which invalidates the preeminent present day notion that volatility is time varying. Additionally, a few studies [8, 9, and 10] use GARCH type modeling to examine volatility spillovers from interest rates to banking sector returns, while ignoring other macroeconomic indicators such as the exchange rate. This is notwithstanding the fact that foreign currency trading has been increasingly taken up by commercial banks in a bid to diversify their income streams; and that exchange rate volatility, which can readily influence volatility of commercial bank returns, has been increasing steadily since the advent of exchange rate regulation and with the contemporary heightening of globalization and economic integration [11].

Thus this paper seeks to examine how interest rates and exchange rates affect the volatility of banking stocks in Kenya, as well as the pertinent response asymmetries. The EGARCH framework [1], which is able to account for volatility spillover as well as response asymmetries, is utilized for empirical analysis. Evaluation of response asymmetries is driven by the fact that negative shocks lead to a higher rise in volatility as compared to positive shocks of equal magnitude [12].

In using an EGARCH approach to examine the impact of interest and exchange rates on volatility bank stock returns, we seek to fulfill three specific objectives. First, we determine the existence of own price spillovers in bank stock returns. Second, we determine the spillover dynamics of bank stock returns, interest rates and exchange rates on volatility of bank stock returns. Finally, we investigate the presence of asymmetric responses to shocks on by the volatility of bank stock returns.

The remainder of the paper is organized as follows: Section 2 elucidates the empirical framework while Section 3 outlines the study's data and Section 4discusses the econometric methodology. Section 5 discusses the empirical results and ultimately, Section 6 presents the conclusion.

2 Empirical Framework

Volatility spillover is described as the tendency of the level of volatility in one market to influence the level of volatility in other markets [13]. [14] posits that volatility spillover almost always happens between markets which have a high level of economic and financial integration. Ostensibly, these linkages provide the transmission channels for intra-market volatility transmission. [10] note that although the issue of volatility spillovers between macroeconomic indicators and the stock market in general is well addressed in the literature, evidence on the dynamics of this relationship with a particular focus on the banking sector is scanty. [15] note that it is common for volatility in the macro economy to have implications on volatility of banking stocks. [16] add that the banking industry is a major player of any macroeconomic environment and as such, shocks to most macroeconomic indicators will have a ripple effect, thereby influencing volatility of the banking industry.

[17] posits that a major drawback in the existential literature on volatility spillover linkages is the assumption that volatility is static. This notion has been debunked by overwhelming

empirical evidence which has shown volatility in financial markets to be both conditional and time varying. Thus, [18] states that empirical frameworks which assume time-varying volatility, such as the ARCH/GARCH class of models, are most aptly suited for modeling volatility spillover dynamics.

There is more empirical literature on the relationship between interest rates and volatility bank stock returns vis-à-vis the influence of exchange rates on the volatility of bank stock returns. Using a multivariate EGARCH framework, [10] investigated volatility spillovers from short- and long-term interest rates to the stock returns of three bank portfolios in the USA. The study found evidence of asymmetrical responses to shocks from both short and long term interest rates on all three bank portfolios. This essentially means that bank stock returns are more reactive to negative interest rate changes than positive interest rate changes. Further, [19] utilizes the Two-Factor Arbitrage Pricing framework to explore that relationship between shocks to long term interest rates and volatility of returns of an index comprised of 10 US banks' stocks. The study provides strong evidence that volatility of bank common stock returns is very sensitive to shocks of the long-term interest rate.

[20] explores the link between exchange and interest rates and mean share prices of listed commercial banks in Kenya. The study finds evidence of unidirectional granger causality from Forex rates to mean share prices of listed Banks. Using OLS and GARCH (1,1) frameworks, [21] investigate how changes in interest rates and foreign exchange rates influence Turkish banks' stock returns. The results yield evidence of significant influences on the conditional volatility of bank stock return by the two indicators.

As evident above, there is vast literature on the influence of interest and exchange rates on bank stock returns around the globe, and especially in the global north. Nevertheless, there is a gap in the literature in that there is scanty extant literature on this subject matter in the developing world. In Sub-Saharan Africa, it is virtually nonexistent. In the light of the foregoing, this study aims to fill this gap by focusing on the Kenyan market. Kenya is a middle income country which is considered an economic powerhouse in East and Central Africa; and hence the study's findings can be extrapolated to make inferences in many similar economies of the developing world and/or sub Saharan Africa.

3 Data

Table 1 presents the descriptive statistics of the sample. Weekly data for the 3rd Oct2008to8th Feb Dec 2019 period - a total of 513 observations - was utilized for empirical analysis in this paper. The data was obtained from the Central Bank of Kenya. The banking stock returns(RBANKING) variable was proxied by daily returns on a capitalization weighted portfolio of listed banking stocks. For the interest rate (RIR), the 3 month T-bill yield was used; while for the exchange rate (RXR), the exchange rate for the Kenya Shilling per United States Dollar was utilized. The interest and exchange rates for each week are expressed in terms of percentage change over the previous week.

Table 1: Descriptive Statistics

	RBANKING	RIR	RXR
Mean	0.0006	-0.0029	0.0006
Median	0.0015	0.0000	0.0004
Maximum	0.1489	0.9734	0.0576
Minimum	-0.1373	-1.2548	-0.0563
Std. Dev.	0.0262	0.2409	0.0086
Skewness	-0.2455	-0.2194	0.2132
Kurtosis	7.9585	6.8624	14.5911
Jarque-Bera	530.704**	322.985**	2875.689**
F-statistic	11.78**	17.388**	53.25740**

It's evident that in all three time series, there are high differences between maximum and minimum observations, thus implying prevalence of susceptibility to shocks. Further, all series have skewed distributions. Observations for the banking sector returns and interest rate are negatively skewed while those of the exchange rate are positively skewed. It can also be noticed that all three series have high levels of excess kurtosis and hence are leptokurtic.
The significant Jarque-Bera statistics affirm that the variables are not normally distributed. These findings are in line with *a priori* expectations. The literature [22, 23, and 24] holds that returns of financial time series usually are not normally distributed. Rather, they have non-zero skewness, leptokurtosis and fat tailed distributions. The F-statistic values refer to the F statistics of the ARCH LM test for ARCH effects. These statistics are strongly significant, thereby implying the presence of ARCH effects in all three variables. This is crucial since ARCH/GARCH type models cannot be fitted using data which doesn't exhibit ARCH effects.

4 Econometric Methodology

The study employs [1]'s EGARCH model for empirical modeling. The EGARCH model is deemed apt since it allows for lagged own and cross shocks (from the interest and exchange rates) to asymmetrically influence the volatility of banking stock returns. As compared to competing models, such as the GJR-GARCH and Quadratic GARCH models, the exponential GARCH model is considered superior since it is positive-definite by design, and hence it cannot give rise to a negative variance [10]
The mean equation for this study was specified using the autoregressive (AR) model below:

$$R_{BANK,t} = B_0 + B_1 R_{BANK,t-1} + \varepsilon_t$$

B_0,and $B_1$are coefficients to be estimated. $B_0$is the intercept of the mean equation while B_1 reflects the extent to which the banking stock returns are autoregressive, i.e. they depend on their own single lags. ε_t is the residual of the mean equation. It is a white noise process which follows a normal distribution with a mean of zero and a definite variance σ_t^2. $R_{BANK,t}$ is the return of the banking stocks as at any given week t. It is deemed to be influenced by its own value in the previous week($R_{BANK,t-1}$). The conditional volatility of banking stock returns is modeled using [1]'s variance equation in which the interest rates and foreign exchange rates are incorporated as exogenous variance regressors.

$$\boldsymbol{ln}(\sigma_t^2) = \alpha_0 + \alpha_1(|z_{t-1}| - E[|z_{t-1}|]) + \alpha_2 z_{t-1} + \alpha_3 \boldsymbol{ln}(\sigma_{t-1}^2) + \alpha_4 R_{INT,t-1} + \alpha_5 R_{FX,t-1}$$

z_t is a standardized residual such that $\varepsilon_t = z_t \sigma_t$while σ_t^2 is the conditional volatility of the banking stock returns as at week *t.* α_0, α_1, α_2, α_3, α_4 and $\alpha_5$are parameters to be estimated. α_0 is the intercept of the variance equation while parameter α_1 measures the extent to which volatility of banking stock returns depends on its own single lagged standardized shocks. α_2 measures the asymmetry effect and α_3 measures the persistence of conditional volatility in banking stock returns. Finally, α_4 and α_5 measure the influence on volatility of banking sector returns from the interest rates and foreign exchange rates respectively.

5 Empirical Results

The results of fitting the EGARCH model are shown in table 2. The outcome shows that there is a significant own return spillover effect in the banking sector, and thus the banking stock

returns in any given week are strongly influenced by their levels in the previous week. However, the intercept for the mean equation is not statistically significant.

Table 2: Maximum likelihood estimates of the EGARCH model

Variable	Parameter	Estimated Coefficient	Std. Error	z-Statistic	Prob.
Mean Equation					
-	B_o	0.002	0.001	1.463	0.144
$R_{Bank,t-1}$	B_1	0.148	0.043	3.464	0.001
Variance Equation					
-	α_0	-0.591	0.168	-3.521	0.000
$(\lvert z_{t-1}\rvert - E[\lvert z_{t-1}\rvert])$	α_1	0.115	0.045	2.586	0.010
z_{t-1}	α_2	0.029	0.015	2.011	0.044
$ln(\sigma^2_{t-1})$	α_3	0.934	0.020	45.992	0.000
$R_{INT,t-1}$	α_4	0.182	0.170	1.075	0.282
$R_{FX,t-1}$	α_5	6.813	2.425	2.810	0.005

Table 2 shows that the intercept of the variance equation is statistically significant. Further, there are strong own volatility transmission effects and thus the level of volatility of the banking sector's returns in any week is heavily influenced by its own volatility of returns in the preceding week. Additionally, significant asymmetry effects are detected; thereby indicating that volatility of the banking sector's returns responds more intensely to negative shocks that to positive shocks of the same magnitude.

The results additionally show that volatility is heavily persistent. Therefore, the volatility of banking stock returns as at any given week has a sustained impact its levels of volatility over a long duration into the future. In other words, it takes a considerable amount of time for volatility of banking stock returns to decay. Finally, it is evident that there are no volatility spillovers from interest rates to banking stock returns but there exists significant volatility spillovers from exchange rates to banking stock returns.

6 Conclusion

The study concludes that there exists significant own price spillovers in bank stock returns. Thus the returns of the banking sector as at any week can be partly useful in forecasting the expected returns of this sector for the succeeding week. Further, the study concludes that volatility of banking sector returns is autoregressive and deeply persistent. This means that an observation in a given week heavily depends on its own observation in the preceding week and there is a long duration of time between the incidence of a shock to banking sector returns and dissipation of the resultant volatility.

The study additionally concludes that foreign exchange rates have a significant cross spillover on the volatility of banking stock returns. However, there is no evidence of cross spillover from interest rates to volatility of banking sector returns.

Finally, the study affirms the presence of asymmetric responses to shocks. This implies that volatility of bank stock returns has a higher response to negative shocks than positive shocks of the same magnitude.

7 Recommendations

From the paper's findings, we make several recommendations for policy implications to various stakeholders. For instance, risk managers in commercial banks should be particularly concerned about shocks to exchange rates since they have a cross volatility spillover linkage with banking sector returns. Portfolio managers who are invested in banking stocks could as well utilize these findings for their risk management practices. They should monitor exchange rates keenly and institute pre-emptive volatility mitigation practices against shocks to either the returns of banking stocks or exchange rates because of their significant influence on volatility of banking stock returns. Due to the extant response asymmetries, negative shocks should be mitigated more aggressively vis-à-vis positive shocks.

Since interest rates do not have significantly influence volatility of banking stock returns, the results further suggest that there should be no risk of heightened volatility in this sector in response to bold monetary policy changes. This should inform the regulatory authority's decision making process on monetary policy.

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